

# Going GREEN

HOME

AT HOME

Cut costs &amp; live cleaner!

## Benefits of Going Green

- Buildings that are designed and operated with their life-cycle impacts in mind can provide environmental, economic, and social benefits.
  - Environmental benefits:
    - Respect for and protection of natural habitats and ecosystems
    - Improved air and water quality by avoiding unnecessary pollution
    - Conservation of natural resources
  - Economic benefits:
    - Reduced operating costs (heating, cooling, etc.)
    - Increased property value and enhanced marketability
    - Increased worker/occupant productivity via improved comfort and health
    - Optimized economic performance over the life cycle
  - Social benefits:
    - Enhanced worker/occupant comfort and health
    - Improved aesthetic qualities
- Green building practices that are used to achieve these benefits include:
  - Designing sites to minimize erosion and runoff
  - Orienting lots and buildings to make best use of solar energy and daylight
  - Planning building sites to minimize destruction of the natural environment
  - Preserving native trees and vegetation to the extent possible
  - Conserving water
    - Selecting energy-efficient materials, systems, and components
    - Selecting recycled and recyclable materials
    - Recycling construction materials to reduce site waste



## LEED Evaluation of Green Building

**Leadership in Energy and Environmental Design (LEED)** was established in 1998 by the U.S. Green Building Council to acknowledge and rate structures that are built to be environmental friendly. This system encourages the construction of energy- and resource-efficient buildings that are healthy for the environment.

### LEED for Homes

**LEED for Homes (LEED-H)** is an initiative to promote sustainable practices for home building and provide national consistency in defining what qualifies a home as green. The LEED-H rating system measures overall performance of residential structures.

- All grading is done by a third party.
- Material selections and construction techniques are recorded and documented.
- Energy performance is tested.
- The evaluation process begins at the design phase and continues until the rating certificate is issued.

### LEED-H Certification

There are many benefits to LEED-H certification, including:

- Most obviously, the benefits of reduced energy bills and a feeling of great responsibility to the environment
- Increased value of your home
- Marketability of a green home
- Tax breaks

LEED-H certification is broken down into 8 credit categories focusing on 18 mandatory minimums.

- Innovation and design process (11 points):** Evaluates special design methods and the innovation of the project.
- Location and linkages (10 points):** Evaluates placement of home with

consideration provided for the social and environmental consequences and effects.

- Sustainable sites (22 points):** Evaluates minimization of the project's impact on the site.
- Water efficiency (15 points):** Evaluates water efficiency, such as reusing gray water and/or capturing rainwater.
- Energy and atmosphere (38 points):** Evaluates the efficiency of the heating and cooling system.
- Materials and resources (16 points):** Evaluates how materials and resources were managed throughout construction.
- Indoor air quality (21 points):** Considers the improvement of air quality as a result of controlling indoor pollution.
- Awareness and education (3 points):** Evaluates the orientation process and training procedures involved in educating the tenants and/or building manager.

The rating of certified, silver, gold, or platinum is based on the number of points awarded to a home, with a total possible score of 136.

## LEED-H Certification Ratings

Rating	Points Required
Certified	45–59
Silver	60–74
Gold	75–89
Platinum	90–136

**NOTE:** Point threshold is reduced for smaller homes and raised for larger homes.

## Green Materials



### Types

- Recycled:** Could appear to be brand new; these materials are recovered but then placed back into the manufacturing process to make them appear new or allow them to be used as another valuable resource.
- Reclaimed:** Might also be referred to as vintage; these materials are salvaged and could be used for something totally different than what they were originally intended for.

### Product Certifications

- Carpet and Rug Institute (CRI):** Identifies and certifies carpets that have very low emissions of harmful chemicals. [www.carpet-rug.org](http://www.carpet-rug.org)
- Forest Stewardship Council (FSC):** Certifies that a product has been sustainably harvested, which means that species of wood has been re-planted for future generations. [www.fscus.org](http://www.fscus.org)
- GREENGUARD:** Identifies interior materials with low chemical emissions. [www greenguard.org](http://www greenguard.org)
- Green Seal:** Conducts independent and rigorous environmental tests on household cleaning products, paints, construction equipment, and more and identifies products that meet specific environmental standards. [www greenseal.org](http://www greenseal.org)
- Scientific Certification Systems (SCS):** Verifies agricultural and environmental product claims as being environmentally preferred and certifies green products; products include carpets, doors and windows, paints, wall coverings, adhesives, sealants, and more. [www scscertified.com](http://www scscertified.com)
- Cradle to Cradle (C2C) Certification:** Certifies products that are safe to humans and the environment and designed for future life cycles; many products have been listed under the C2C label. [www c2ccertified.com](http://www c2ccertified.com)

**TIP** The U.S. Environmental Protection Agency's (EPA) Environmentally Preferable Purchasing Program offers information about environmentally preferable products and services. Although the program was launched to help the federal government and stimulate demand for green products and services, it is also helpful to consumers who want to learn about environmentally preferable products and know where to buy them. For information on environmentally preferable products, a complete database of standards for green building materials, and more, visit the EPA's website ([www.epa.gov](http://www.epa.gov)).

## Indoor Environment Facts

- Most people spend about 90% or more of their time indoors.
- Indoor levels of pollutants may be 2–5 times higher—and occasionally more than 100 times higher—than outdoor levels.
- The U.S. Environmental Protection Agency (EPA) has consistently ranked indoor air pollution as among the top 5 environmental risks to public health.
- According to the EPA, indoor air pollution costs U.S. corporations up to \$60 billion each year in lost productivity.
- Indoor contaminants, such as dust mites, molds, cockroaches, pet dander, and secondhand smoke, can trigger asthma attacks. According to the Centers for Disease Control and Prevention, more than 20 million people, including over 6 million children, have asthma, accounting for over 10 million outpatient medical clinic visits per year. An estimated 14 million school days are missed each year due to asthma.
- In 2005, the U.S. Surgeon General warned that radon is the second-leading cause of lung cancer and estimated radon to be responsible for more than 20,000 deaths per year.
- Toxic mold is currently the leading cause of indoor air pollution, according to the EPA. Molds produce allergens (substances that can cause allergic reactions), irritants, and in some cases, potentially toxic substances (mycotoxins). Controlling moisture within your home is vital to preventing mold.

**Promote good indoor air quality** by controlling pollution sources, by carefully choosing building materials to avoid those known to be toxic or to give off toxic emissions (e.g., formaldehyde in manufactured wood, VOCs, or lead-based paint), and by ensuring proper ventilation and moisture control.

## Environmentally Unfriendly

- Volatile organic compounds (VOCs):** These compounds are emitted as gases from certain solids or liquids and include a variety of chemicals that can have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to 10 times higher) than outdoors.
  - Thousands of products emit VOCs, including paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials, and furnishings.
  - The smell that is emitted from new carpet is a telltale sign that VOCs are present.
  - Build or remodel with low- or zero-VOC finishes**, and you will notice little odor. No smell is a sign of a green home.
- Formaldehyde:** This chemical is commonly used in the manufacturing of building materials (e.g., cabinets, furniture, insulation) in the form of adhesives and may cause cancer in humans. Because it is a by-product of combustion and certain other natural processes, formaldehyde may be present in large concentrations both indoors and outdoors. The particles of this chemical can be released for years after the product has been installed.
  - Other potential sources of indoor formaldehyde exposure include the use of unvented fuel-burning appliances, such as gas stoves or kerosene space heaters, and cigarette smoke.
  - To reduce formaldehyde exposure:**
    - Use “exterior-grade” pressed wood products because they do not contain harmful urea resins.
    - Use air conditioners and dehumidifiers to reduce humidity levels and maintain moderate temperatures.
    - Increase ventilation, especially after bringing new sources of formaldehyde into the home.
  - Lead:** A highly toxic metal, lead can cause permanent neurological damage

to children and adverse health effects in adults. Sources of lead include paint, water (from lead pipes, plumbing fixtures, and solder), and soil. In 1978, the use of lead in household paints was banned.

### To reduce lead poisoning:

- Have your home tested for lead if it was built before 1978.
- Test your home's drinking water.
- Keep your home dust-free.
- Use only lead-safe certified contractors.

## Component Considerations

Component	Suggestions
Batt insulation	<ul style="list-style-type: none"> <li>Choose formaldehyde-free insulation.</li> <li>Consider recycled cotton.</li> </ul>
Carpet	<ul style="list-style-type: none"> <li>Select one that is made from natural fiber and materials.</li> <li>Select one that is backed with wool or similar natural material.</li> </ul>
Ceramic tile	<ul style="list-style-type: none"> <li>Use cement grout rather than adhesives.</li> <li>Choose salvaged tile when possible.</li> </ul>
Decking	<ul style="list-style-type: none"> <li>Use composite lumber, which is made from recycled plastic and sawdust.</li> <li>If you use wood, choose only FSC-stamped wood.</li> </ul>
Drywall	<ul style="list-style-type: none"> <li>Purchase recycled or synthetic gypsum.</li> </ul>
Roof covering	<ul style="list-style-type: none"> <li>Avoid asphalt shingles; select material that will support rainwater collection.</li> <li>Select recycled rubber roofing if possible.</li> <li><b>Remember:</b> Select the lightest color available.</li> </ul>
Stains, paints, and sealers	<ul style="list-style-type: none"> <li>Choose water-based, low- or zero-VOC paint.</li> <li>Consider earthen plaster, which is all natural, as an alternative to paint.</li> </ul>
Vinyl tile	<ul style="list-style-type: none"> <li>Use linoleum.</li> <li>Use any other type of floor covering (e.g., wood, tile).</li> </ul>
Wood (floors, sheathing, cabinetry, etc.)	<ul style="list-style-type: none"> <li>Choose wood that is FSC-stamped and uses low- or zero-VOC adhesives.</li> <li>Consider oriented strand board (OSB), which is a more environmentally friendly alternative to plywood.</li> </ul>

## Rainwater Harvesting

Rainwater harvesting is the simple and low-budget act of capturing and storing rainwater for reuse. The rainwater is typically collected from gutters and stored in barrels or a storage tank. Some states prohibit the collection of rainwater. Check with your state's water resource agency before implementing a rainwater harvesting system.

### Benefits

- Free water source
- Relatively clean
- Reduces pollution from stormwater runoff
- Healthy for plants because it is not chlorinated
- Easy to do, inexpensive, and does not require technical expertise
- Great source of backup water
- Does not have restrictions on use

**NOTE:** A rainwater harvesting system does not rely on city water; therefore, the use of harvested rainwater may be exempt during mandatory water restrictions. Check with your local utility company.



### DID YOU KNOW?

Lawn and garden watering make up nearly 40% of household water use in the summer, and a rain barrel can save most homeowners about 1,300 gallons of water during that time.

### Use of Captured Water

- Can be filtered and used as potable water
- Can easily be used for nonpotable purposes (e.g., to wash vehicles, clean exterior of house, or bathe pets)
- Can be used for irrigation and hand watering
- Can be used to flush toilets and wash clothes
- Can help maintain water levels of pools, ponds, and fountains

## Collection Methods

- Barrels:** Simple, inexpensive, and effective. Nearly any type of barrel can be placed under each downspout to collect all water that runs off of the roof.

Although easy to implement, this type of system may only provide enough storage for casual water reuse, since the small size of the barrels can limit the amount of captured water.

- Dry system:** Average cost is about \$500, but the system is fairly easy to implement. A storage tank (or cistern) manufactured specifically for this purpose must be installed near the house. A pipe system connects all downspouts to this central collection reservoir.

- Wet system:** Typical cost is about \$1,500 or more. Installation is more complex than the previously listed types. In this method, all downspouts are connected to a series of underground pipes that lead to a tank. As the pipes fill, the water will rise in the vertical pipe connected to the tank and spill into the tank.

## The Math

- Calculate the square feet of the area from which water will be collected.
- Multiply the square feet by 0.6 to estimate the total amount of water (in gallons) to be collected per inch of rainfall. For example, for a home with a 2,000-square-foot roof, the calculation would be  $2,000 \times 0.6 = 1,200$  gallons. So for every inch of rain that falls, you could collect 1,200 gallons of rainwater.

## Forecasting Collection

- To plan and forecast the amount of rainwater you will collect, identify your annual average precipitation based on your geographical area.
- View a precipitation map to estimate average rainfall in your area. **NOTE:** Since a rainwater harvesting system depends on precipitation, a backup water supply is usually needed.

## Gray Water Reuse

Gray water is used water that is drained from bathroom sinks, bathtubs, showers, washing machines, and laundry sinks. In contrast, water that is drained from toilets and sometimes kitchen sinks is referred to as black water.

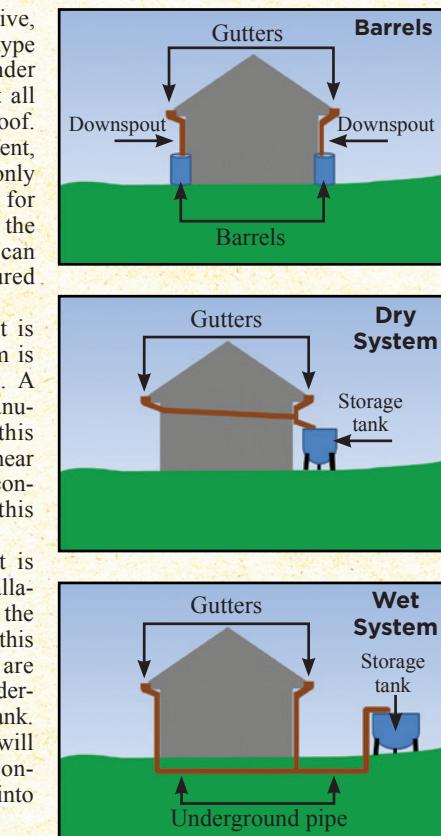
**NOTE:** Claiming gray water can be somewhat complicated and will usually involve the help of a professional.

## Benefits

- Free, since this is the second use of the water
- Relatively clean and requires minimal treatment
- Can reduce your water bill significantly

## Did You Know?

Daily indoor per capita water use is 69.3 gallons, of which about half could be used as gray water.\* This table provides a breakdown of daily indoor water use.



## Water Conservation

### General Tips

- Only operate the dishwasher, washing machine, and similar appliances when they are full.
- Sweep rather than use water to clean driveways and sidewalks.
- Keep a close watch for leaks and repair immediately.
- When handwashing dishes, do not allow water to run continually. Use two sink compartments: one for soapy water and one for rinsing water.
- Always cover your swimming pool to prevent evaporation.
- Do not overwater your lawn.
- Time showers of each family member and remind one another to shower quickly.
- Wipe your car daily to reduce the amount of times you will need to wash it.

### Fixture Tips

- Replace older toilet models that use 3.5–7 gallons of water with ones that use 1.6 gallons per flush.
- Use a toilet tank dam on older toilets to reduce the amount of water used with each flush.
- Conduct a dye test on your toilet tank. Drop food coloring into the storage tank; do not flush. Wait 45 minutes to an hour, then check the bowl for traces of the food coloring. If you see color, the toilet tank has a leak.
- Replace old shower heads with new, efficient shower heads. Older models can use between 5 and 7 gallons of water per minute (gpm).
- Install a faucet aerator (filter) on any faucet that does not have one. A faucet that does not have an aerator installed can use up to 7 gpm. A typical kitchen sink aerator will restrict the flow of water to 2.2 gpm. A bathroom faucet aerator can restrict the water to as little as 0.5 gpm. On average, installation of aerators will reduce the faucet water consumption in a home by 33%.
- Consider a dual-flush toilet where a *liquid waste* flush only consumes 0.8–1.1 gallons of water as opposed to the 1.6 gallons of water used for a *solid waste* flush.

## Solar Water Heater



A solar hot water system (also called a solar domestic hot water system or solar thermal system) can be a very cost-effective method of heating water for use in the home.

### Benefits

- The sun provides the “fuel” used to heat the water.
- When combined with a small photovoltaic system powered by energy generated from the sun, the entire system is independent of the power grid and therefore free (see **Photovoltaics**, p. 6).
- Tax incentives are usually available.
- Most systems are relatively inexpensive and can pay for themselves in sometimes less than two years.

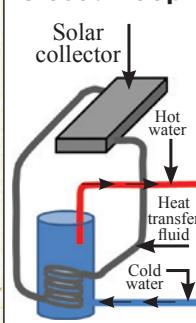
### How It Works

A solar water heating system is composed of collectors and a storage tank. The collectors are insulated boxes containing a system of pipes attached to metal sheeting or fins. Most collectors are covered with tempered glass or plastic to better contain the solar energy. The collectors absorb and retain the heat generated by the sun, and the heated water is stored in an insulated storage tank for later use. Some systems are backed by a common electric or gas water heater. There are two types of solar water heating systems: active and passive.

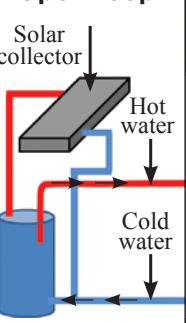
### Active Systems

Active systems use electric pumps, valves, and controllers to circulate water through the collectors. These systems are typically more expensive than passive systems but are generally more effective. An active system is much easier to design and install because the storage tanks do not need to be installed above or close to the collectors. There are two types of active systems: open loop (direct) and closed loop (indirect).

#### Closed Loop



#### Open Loop



## Active Solar Water Heating Systems

Open-Loop Active System	Closed-Loop Active System
Description	
<ul style="list-style-type: none"> <li>Suitable for climates where freezing temperatures are not likely</li> <li>The pumps circulate water through the collectors and into the home</li> </ul>	<ul style="list-style-type: none"> <li>Suitable for climates where freezing temperatures are likely</li> <li>The pumps circulate heat transfer fluid through the collectors and heat exchanger</li> </ul>
Advantages	
<ul style="list-style-type: none"> <li>Simplest and least expensive system</li> <li>Easy to modify if demand for hot water increases</li> <li>Integrates easily with existing water supply</li> <li>Functions at standard pressure</li> <li>Allows for efficient heat transfer directly to the water (no heat exchanger required)</li> </ul>	<ul style="list-style-type: none"> <li>Allows for simple switching between heat exchangers for multiple uses</li> <li>Freeze sensors and drain-down valves are not needed</li> <li>Special solar domestic hot water tanks are available with internal heat exchangers (coils), with or without electric backup</li> <li>Twin coil tanks that allow surplus solar energy to be directed to spa, pool, floor, etc., are also available</li> </ul>
Disadvantages	
<ul style="list-style-type: none"> <li>Recirculates heat from the supply pipes and the bottom of the tank</li> <li>Some stored heat can be lost when recirculating</li> </ul>	<ul style="list-style-type: none"> <li>Generally more complicated than an open-loop system</li> <li>Requires antifreeze, which will need to be monitored and maintained</li> <li>The collector loop will need to be pressurized</li> </ul>

### Passive Systems

Passive systems do not use a pump to circulate water from the collectors to a storage tank or other location. These systems work by using gravity—specifically, the tendency of hot water to rise above cold water—and water pressure. There are two types of passive systems:

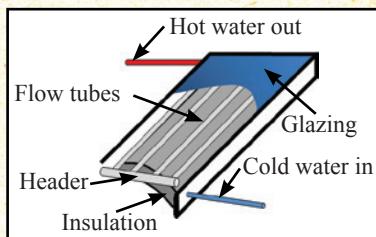
- Direct (integral collector storage, or ICS, system):** A direct system means the water to be used is run directly through the solar collector. This type of system can be as simple as taking a 50-gallon barrel, painting it black to absorb heat, collecting water, and using buckets or a siphoning system to distribute the water for use. The biggest danger here is the inability to control temperature; the sun can heat water to scalding temperatures.
- Indirect (thermosyphon system):** This type of system is more complex and requires the stored water to be separate from the collector. In this system, a box-type collector heats the water and, because the storage tank is positioned higher than the collector, convection draws the heated water up into the storage tank without using a pump.

**TIP** Before installing a solar water heating system, investigate local building codes, zoning ordinances, and subdivision covenants, as well as any special regulations pertaining to the site. A building permit may be required to install a solar energy system onto an existing building.

### Collectors

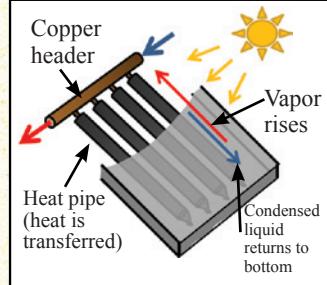
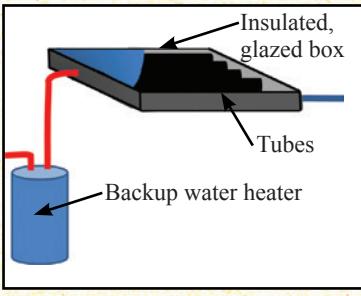
A solar thermal collector is designed to collect heat by absorbing sunlight. For the purpose of heating water, there are three basic types:

- Flat-plate collectors:** These are insulated, weatherproof boxes that contain a dark absorber plate under one or more glass or plastic/polymer covers. Unglazed flat-plate collectors have a dark absorber plate made of metal or polymer without a cover and are typically used for solar pool heating.



**• ICS systems or batch systems:** These are designed for mild-freeze climates because the outdoor pipes could freeze. ICS systems feature one or more black tanks or tubes in an insulated, glazed box. In this system, the solar collector preheats the cold water as it passes on to the conventional backup water heater. The backup ensures the supply of hot water.

**• Evacuated-tube solar collectors:** These are frequently used for commercial applications. This type of collector features parallel rows of glass tubes. Each tube contains an outer glass tube and a metal absorber tube that is attached to a fin. The fin's coating absorbs solar energy but inhibits radiative heat loss.



### Collector Orientation

Collectors should be oriented in a manner to maximize the amount of daily and seasonal solar energy they receive. Factors to consider:

- Mount the collector on the side of the roof that will be exposed to the sun based on your geography.
- Place the collector in an area where the local landscape features do not shade the collector.
- The angle of tilt at which the collector is placed is important. The optimal angle is equal to the latitude of the location, but mounting the collector flat (for aesthetics) will not greatly reduce the system's performance.

### Solar Water Economics

Even though the cost of installing a solar water heating system is much higher than installing a conventional water heating system, in many cases the breakeven point can be reached quickly. On average, water heating bills should drop between 50% and 80% with the use of a solar water heating system. To evaluate your savings, consider:

- Amount of water used
- Tax breaks from having the system in use
- Geographic location (some areas will produce more heat)
- The system's performance

### Sizing a Solar Water System

Before installing a solar water heating system, determine what size storage tank and collector(s) you will need (see **Storage Volume** table).

- For active systems, the size of the tank should be increased with the size of the collector. For each square foot above the size specified in the **Collector Area** table, increase the tank size by 1.5 gallons.
- In warm and sunny areas, increase the tank size by 2 gallons per square foot rather than 1.5 gallons. This is to help prevent the system from overheating when demand for hot water is low.

### Storage Volume

Tank Size	Serves
Small tank (50–60 gallons)	1–2 people
Medium tank (80 gallons)	3–4 people
Large tank (120 gallons)	4–6 people

### Collector Area

Serves	Area
First 2 family members	20 sq. ft.
Each additional family member	Add 8 sq. ft.*

\*Add 12–14 sq. ft. if you live in the northern United States.

**TIP** Since solar water heaters rely on the sun for fuel, they may at times have a limited supply of energy. Spread out tasks that require the use of hot water. For example, if you do a load of laundry one day, consider running your dishwasher a few days later.

# Energy

On average, 30% of energy consumed in buildings is used unnecessarily or inefficiently. Reducing nonrenewable energy usage inside the home by even a small percentage can significantly reduce pollutants to the environment, thus reducing contribution to acid rain, global warming, and depletion of natural resources.

## Ways to Conserve Energy

- Be a switch hitter—turn off lights that are not necessary.
- Lower thermostats in winter and raise them in summer.
- Use a power strip or surge protector to turn off power to all appliances when not in use (e.g., the power to a TV, DVD player, and audio receiver could be turned off with one switch if they are all plugged into one power strip).
- For exterior lighting, use lights that have motion sensors.
- Install dimmers on lights.
- Install smart switches (e.g., a switch in the jamb of a door that will turn the light on when the door is opened and turn the light off when the door is closed).
- Do not leave computers on when not in use. According to the U.S. Department of Energy, you could save \$90 per year by doing this.
- Use a laptop rather than a desktop computer. A laptop uses about 20% fewer watts than a desktop computer.
- Switch to more energy-efficient appliances, systems, and building features, such as a more efficient water heater, specially designed windows, etc.

### SMART GADGET

Invest in an **energy monitoring device**. The device will track the amount of electricity your household uses—and the costs of that usage—in real time. This device can help you reduce your energy consumption and decrease your monthly bills.

# Lighting

## Lightbulbs

Manufacturers are now required to use new labeling on lightbulb packaging to help consumers choose bulbs that are the most efficient for their needs. The new labels also include the bulb's brightness measured in lumens and the estimated yearly energy cost projected for that bulb. Carefully choosing the right bulb is important in managing energy costs; the right bulb can make a significant difference in cost over the course of a year.



### Incandescent Lightbulbs

- These lightbulbs produce light when an electric current passes through a filament, causing it to glow. This is based on the original design of Thomas Edison. This type of bulb is being phased out of use because it is considered to be less efficient than newer designs.
- **Points to consider:**
  - Produce more heat than light
  - Waste a lot of energy

### Fluorescent Lightbulbs

- These lightbulbs produce light when an electric arc passes between

## Average Home Energy Consumption

Appliance or Energy Usage	% Energy Consumption
Space heating	45
Water heating	18
Space cooling	9
Computer & electronics	6
Lighting	6
Cooking	4
Refrigeration	4
Wet cleaning	3
Other	5

### Did You Know?

According to the U.S. Department of Energy, 75% of the electricity used to power electronics in the home is consumed while the products are turned off.

cathodes to excite mercury and other gases, producing radiant energy that is then converted to visible light by a phosphor coating that lines the inside of the bulb.

### Points to consider:

- Use up to 75% less energy than incandescent bulbs
- Can last up to 20 times longer than incandescent bulbs
- Generate less heat than incandescent bulbs
- Contain mercury and should be disposed of properly (contact your local recycling company or waste management company about disposal procedures)

### Light-Emitting Diodes (LEDs)

• LEDs produce light when voltage is applied to negatively charged semiconductors, causing electrons to combine and create light. Because of their small size, many LEDs are combined to produce a single light.

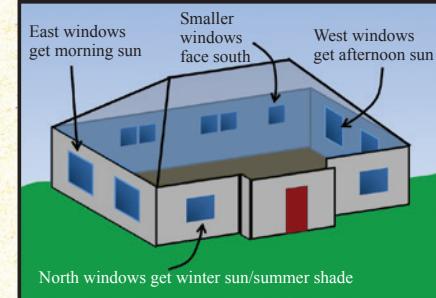
### Points to consider:

- Use 90% less energy than equivalent incandescent lightbulbs
- Could last as many as 100,000 hours
- Do not contain mercury

## Natural Light

If you are building and are not restricted by neighborhood covenants, plan the placement of the home around the rotation of the sun. By positioning the structure properly, you can reduce energy use significantly.

- Position the building so that rooms needing light in the morning are located in the southeast quadrant.
- Rooms that are used later in the day should be positioned to face west.



## Skylights

Skylights provide natural illumination from overhead and can be the best source of natural lighting for rooms that are deep within a structure and do not have windows. In an optimal situation, a skylight should be positioned on the roof in a way to prevent too much heat gain from the sun. Ideally, the skylight would be placed on the north side of the roof.

**TIP** Roof overhangs should be used to shield the sun in the summer but allow it to penetrate the house in the winter.

## Sun Tunnels

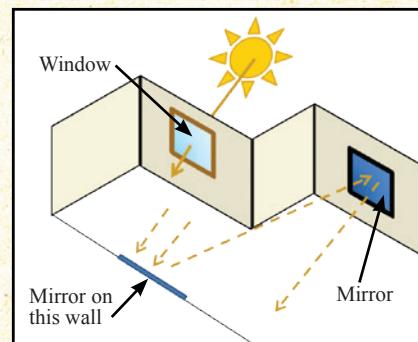
A sun tunnel, similar to a flex pipe used to vent a clothes dryer, is used to channel sunlight to a location that would not otherwise benefit from natural light. The pipe is made of a reflective material. As the light travels through the tunnel, it reflects from one side to the other, boosting the brightness of the light.

## Mirrors

Mirrors of any type can be used to reflect natural light or light produced by a lightbulb. By installing two mirrors that face one another, you can reflect available light to another area. Adjust the angle of each mirror to strategically direct the beam of light.

## Light Shelves

Light shelves are horizontal fins installed just above the eye level point on a window and are positioned to bounce the light up toward the ceiling.



# Appliances

## Appliance Ratings

- ENERGY STAR®:** Choose appliances that have earned the ENERGY STAR. These appliances will save you money on your energy bill. The U.S. Environmental Protection Agency and the Department of Energy have established criteria to award this rating to appliances that have proven to save 10%–50% on energy consumption.
- EnergyGuide:** Many appliances carry the yellow EnergyGuide label, which includes the kilowatt-hours (kWh) the appliance uses. To get an estimate of your yearly operating cost for an appliance, calculate the number of hours you will use the appliance on an annual basis and multiply the total by your local electricity rate found on your utility bill.



## Refrigerator

It is important to regulate the temperature of a refrigerator because each degree lower than necessary will increase the energy use by 5%.

- Set the thermostat so that the refrigerator will chill to a range of 36°F–38°F.
- Set the thermostat so that the freezer component will chill to a range of 0°F–5°F.

## General Tips

- Try to plan grocery inventory to prevent the need for more than one refrigerator.
- Place only items that need to be refrigerated in the appliance.
- Keep the door closed as much as possible.
- Replace the appliance if it was made before 2001 (older models can use five times as much energy as newer models).

## Tankless Water Heater

A tankless water heater, also known as an instant water heater, is very efficient (and can potentially save up to 30% on your energy bill) because water is not heated continually, such as when you are not at home. This type of heater only heats the water as it flows through the appliance.

## Benefits

- You will never run out of hot water.
- Multiple people can be using hot water at the same time and not run out.
- The heater takes up very little space.
- The heater saves water because there is no need to run the water until it is warm.

**NOTE:** If supply lines run through a basement or crawl space, they should be insulated. This can reduce the amount of energy it takes to warm the water. This applies to any type of water heater.

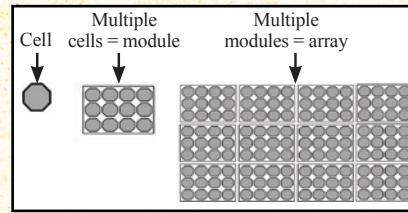
# Photovoltaics

Photovoltaic (PV) technology produces electricity from electrons that are freed by the interaction of sunlight with certain semiconductor materials, such as silicon, in the PV module. Electrons are collected to form a direct current of electricity. By installing a PV system, you can produce your own electricity and not be dependent on power lines.



## How It Works

A solar cell is the basic building block of PV technology. Many solar cells are wired together to form a PV module. When modules are connected, they form a PV array. A PV system consists of one or more modules that are



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connected to an inverter. The inverter changes the PV system's direct current electricity to alternating current electricity to power devices, and this electricity will be compatible with the manner in which the power company supplies electricity. PV systems produce power intermittently because they work when the sun is shining; therefore,

- More electricity is produced on a sunny day.
- Cloudy days will significantly reduce output.
- PV systems work best during summer months when the sun is higher in the sky and the days are longer.

Because of these variations, batteries are used to store the power generated from the system. Stored power from batteries can also be used simultaneously with power supplied by the utility company.

## Feasibility Audit

Is your home conducive to a PV system?

- Consider the amount of sunlight your site receives. It should have unobstructed access to the sun for most of the day and throughout the year.
- The sun's path should be clear and unobstructed by trees, roof gables, chimneys, buildings, etc.
- The placement of the arrays is important. Ideally, the arrays should be placed on a south-facing roof.

**NOTE:** A PV system is a very expensive means of providing electricity. It is like prepaying your electricity bill for many years to come. If you are concerned only with bottom-line return, this may not be the route to take.

# Landscaping

Careful landscaping with trees, bushes, and ground cover can cut energy consumption of heating and cooling equipment by as much as 25%.

- Trees are most effective when located next to windows, walls, and air conditioners and on the side of the home receiving the most solar exposure.
- Shade to the southwest and west is especially important for blocking peak solar gain during the summer in the late afternoon.
- Trees located more than about 35 feet from the home are probably too far away to be useful for shading it.
- Deciduous trees are helpful in passive solar design because they temper the summer's heat but allow the winter sun to peek through and warm the house.

## Plant Smart

Plant vegetation that requires minimal watering, fertilization, and other maintenance.

- Planting native and drought-tolerant species will lower the need for water, fertilizers, and pesticides.
- Make every attempt to conserve the trees and vegetation that are on the site before construction begins.
- Keep soil healthy for strong plants. For new construction, remove and protect the top 6 inches of topsoil in areas that are to be disturbed by construction. Removing and protecting this top layer and then replacing it after construction will help keep the soil in that area healthy.
- Strategic placement of plants can have a major impact on home energy use and comfort. A combination of low bushes and evergreens makes an effective windbreak. Placing trees twice the distance from the house as they are tall can reduce the wind's effect on the house by 75%.

